Port and Shipping Development in the 21\textsuperscript{st} Century

by

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Outline

1. Introduction
2. Long-term trends
3. Implications for ports and waterways
4. Consequences in planning and design
5. Case: Inland Water Transport
6. Conclusions
1. Introduction

- This presentation on shipping and port development is the result of my practical experience as a port planner, combined with academic research with MSc and PhD students.

- Port Masterplanning requires a broad look into an uncertain future. I have tried to look far beyond the normal forecast period of 20-30 years.
2. Long-term trends

(i) Transition from Industrial to Post-Industrial Age

<table>
<thead>
<tr>
<th></th>
<th>Production mode</th>
<th>Production factors</th>
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<tbody>
<tr>
<td>Industrial age</td>
<td>Manufacturing</td>
<td>Capital, labour</td>
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<td>(1800 - 2000)</td>
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<td>Post-Industr.</td>
<td>Services and</td>
<td>Knowledge, skills,</td>
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<td>Age (2000 - ?)</td>
<td>networking</td>
<td>and information</td>
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</table>
(ii) World population

(iii) World GDP

Source: Kwasnicki, 2013
GDP is relevant because of its relation with transport and in particular port throughput.

NW-Europe: 1945-2009

Source: Van Dorsser, 2015
(iv) Port throughput

When we apply this relation to probabilistic forecasts of GDP one gets for the total throughput, for instance of the NW-European ports:

Source: Van Dorsser, 2015
(v) Environmental and Societal trends

a. Climate change: mean global surface temperature rise

Source: IPCC Climate Change 2014
Paris Agreement, December 2015:

“holding global average temperature change to well below 2 °C and making efforts to keep it at 1.5 °C”

→ Nationally defined mitigation and adaptation measures
b. Energy transition

- Cleaner fuels
  Shift to gas, hydrogen
- Renewable energy
  Wind power, solar power, biofuels
- Increasing “energy productivity”
  = the economic output per energy unit
Source: Energy Transition Outlook 2017, DNV-GL
c. Sustainability measures

- Reuse of materials
  Recycling, cradle to cradle, circular economy

- Use of biological products
  Biotechnology, genetic engineering
Recycling:

From ship breaking to Green Ship Recycling:

- demolition yards with accident-free working conditions
- recycling of more than 95% of all material
c. Manufacturing

- 3D-printing  )  →  shift production locations
- Robot technology  )  back to consumption location

d. Integrated networks (IT)

- Smart grids
- Intermodal transport
- Automation
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3. Implications for Shipping and Ports

(i) Changes in transport over water

- Reduction of coal and crude oil transports
- Increase of LNG and other gas transports
- Reduction of intercontinental container transports
- Increase of coastal and Short-Sea Shipping
- Increase of Inland Waterways Transport (IWT)
Floating Storage and Regas Unit, Bahia Blanca, Argentina
(ii) Changes in shipping

- Use of cleaner fuels (biodiesel, LNG, electricity)
- Fully integrated planning of vessel arrival time and handling time in port (stevedoring, bunkering, supplies) and intermodal connections
- Automated sailing ships?
Wake of a 3000 TEU container ship, St. Lawrence River, Sept. 2011
- New IMO regulations limit sulphur emissions from marine vessels to 0.1%
- Gradual change to LNG as fuel: in 2018 130 ships sailing and 120 on order
Automation

- From remote-controlled to automated and autonomous sailing commercial ships
- Much research, several projects well advanced.
(iii) Changes in the seaports

- Reduction ship emissions (WPCI and Env. Ship Index)
- Modernisation of refineries and petrochemical industries, use of biofuels, synthetic gas, etc.
- Import of biomass for energy production
- Infrastructure for Carbon Capture and Storage (CCS)
- Improved intermodal infrastructure

→ Target Port of Rotterdam CO₂ reduction of 95% by 2050!
Agreement with refineries and electricity producers signed on 26 October 2016
World Port Climate Initiative (WPCI)

- initiated and organized by IAPH
- ongoing projects:
  - Improvement intermodal transport
  - Reduction carbon footprint
  - Online Power Supply (OPS)
  - Environmental Ship Index (ESI)
Environmental Ship Index (ESI)

Initiative of a number of large ports worldwide to provide incentives for ships with reduced emissions (relative to the basic IMO standards)

Incentives:
mostly rebate on port dues

August 2019:
8900 ships registered
54 ports participating
Automation of terminal operations

AGV’s between and stack (1993)

Semi-automated terminal (2013)
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e.g. EnviCom WG 150: Sustainable Ports, A guide for Port Authorities, 2014

Issues and possible solutions with respect to:
- land use planning
- hinterland connections
- environmental impacts  including institutional and social aspects
- climate change and adaptation
- waste management
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4. Consequences in planning and design

- The changes are rapid, compared with the life time of port and waterways infrastructure

- There is a great amount of uncertainty related to the forecasts and predictions

→ Hence the need for **flexibility** and **adaptability** in planning and design
Flexibility

- modular design of structures
- modular lay-outs
- floating structures
Floating structures:

Kamigoto floating oil storage base in Nagasaki, Japan
Adaptation
Adaptive Planning as part of the Masterplanning process → The Flexible Port, Poonam Taneja, 2013
5. Case: Inland Water Transport

- Used to be a very important mode of transport in Western Europe
- After WW2 road transport grew faster, IWT mostly for bulk
  6-barge push-tow on the Rhine
Main European IWT System
Source: Bureau Voorlichting Binnenvaart (2009)
During the last twenty years we see an upturn, due to

- environmental advantages of IWT (less emission per unit cargo)
- development of intermodal transport $\rightarrow$ improved logistics (IT!) facilitate container transport by barge
From conventional barge (120 TEU) to a newly designed barge for 500TEU
Consequences for sea ports

Separate Barge Terminals
PIANC Working Groups

- InCom WG 125 Guidelines and Recommendations for River Information Systems (RIS), 2019
6. Conclusions

(i) Long term trends predict a slowing down of economic growth, a shift from fossil to renewable energy sources and a reduction of inter-continental container transports.

(ii) The changes in ports will be more rapid, but they are uncertain. In response Adaptive Port Planning is required and the infrastructure has to become more flexible.

(iii) IWT is expected to grow, if realising its environmental advantages and utilising modern IT-technology.

(iv) Ports will become nodes of high-tech logistics, industry and services, requiring also well educated employees.
Thank You